ABSTRACT OF THE DISCLOSURE

A machine for determining field-dependent physical characteristics contains tables of precomputed quadratures and employs them to integrate numerically over a problem boundary. The quadratures are based on products of a kernel function and a basis that spans a wide range of density functions. The kernel function is dependent on a target node's position, and different quadratures are precomputed for different target-node positions or ranges thereof. In the case of at least some of the quadratures, some the basis functions include integrable singularities. The solver divides the problem boundary into a plurality of problem intervals, to which it maps the canonical interval. To integrate a problem interval for a target point, the solver employs a precomputed quadrature that is associated with the target point's relative position and that was generated by using a basis in which a singularity occurs at each canonical-interval location that was mapped to a geometrical singularity on the problem interval. The quadrature results in high-order accuracy even if no individual basis function includes a singularity whose shape is the same as one induced by the geometric singularity. These quadratures can be coupled with a Fast Multipole Method ("FMM") to evaluate layer potentials rapidly and with high accuracy.